meridonal cross-section of the side portion being substantially geometrically similar to a cross-section having:

(a) an outer line formed by fitting an arc of a circle to three points having rectangular coordinates x, y of the nodes as set out in table 3; and

(b) an inner line formed by fitting a line to points having rectangular coordinates x, y of the nodes as set out in table 2.

23. (Amended) An axisymmetric bell having a top portion, a side portion and a mouth, the side portion extending from the top portion to the mouth, a meridonal cross-section of the side portion being substantially geometrically similar to a cross-section having:

(a) an outer line formed by joining a straight line to two points having rectangular coordinates x, y of the nodes as set out in table 6; and

(b) an inner line formed by fitting a line to points having rectangular coordinates x, y of the nodes as set out in table 5.

REMARKS

Applicant's attorney wishes to thank the Examiner for the careful consideration given this case. This response addresses those issues raised in the Replacement Office Action mailed February 14, 2002. Reconsideration of the specification and claims as amended is respectfully requested in view of the foregoing amendments and the following remarks. It is noted that the Examiner

has indicated the allowability of Claims 22 and 23 if rewritten or amended to overcome the objections/rejections under 35 U.S.C. § 112, second paragraph.

Objections to the Specification

The Examiner objected to the abstract of the disclosure as being too brief. The amended abstract submitted hereinabove now conforms with the requirements for an abstract. Entry is respectfully requested.

The required brief description of the drawings section has been presented hereinabove. Entry is respectfully requested.

Objection to Claims 1-14, 16, 18 and 21-23

Claims 1-13, 16, 18 and 21-23 were objected to as being informal and lacking antecedency. Claims 1-3, 12-13, 15-16 and 22-23 have been amended to overcome the Examiner's objections and are deemed allowable. Claims dependent therefrom are also deemed allowable. Reconsideration and allowance of these claims in their amended form is respectfully requested.

Claim Rejections Under 35 U.S.C. § 112, second paragraph

Claims 22 and 23 were rejected under 35 U.S.C. § 112 as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The order, "x,y", of the points from the tables to be used has been set forth in the claims as amended. Reconsideration and allowance of these claims in their amended form is respectfully requested.

Claim Rejections Under 35 U.S.C. § 102(a) and 35 U.S.C. § 103(a)

The Examiner has rejected Claims 1-13 under 35 U.S.C. § 102 as being anticipated by Fountain et al. ("Fountain"). The Examiner has rejected Claims 15 and 19-21 under 35 U.S.C. § 102 as being anticipated by Schoofs et al. ("Schoofs"). Further, the Examiner has rejected Claims 16-18 under 35 U.S.C. § 103(a) as being unpatentable over Schoofs in view of Fountain.

MPEP § 2131 provides that "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described in a single prior art reference." *Verdegaal Bros. V. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). Applicant submits that neither the Fountain or the Schoofs reference expressly or inherently discloses or suggests every element of the invention as now claimed, and these rejections should therefore be withdrawn.

As the specification explains, the sound of a bell is comprised of a plurality of different superposed frequency components. The timbre depends on the relative frequencies and relative strengths of these different components. The classical church or carillon bell has relative frequencies of 1, 2, 2.4, 3 and 4. The first, second and fifth modes are thus octave jumps, the fourth mode is the musical fifth with respect to the second, whilst the third mode is the minor third (the second, third and fourth modes therefore forming the minor triad). This is a very common chord in Western music, especially in tuned percussion. As the description of the claimed invention makes clear, a major third bell (with relative frequencies of 1, 2, 2.5, 3, 4) is also known.

The present invention sets out to provide an harmonic bell, that is, one with modal frequencies in the ratios 1, 2, 3,....., N, where N is a real integer greater than zero, and represents the number of tuned frequency ratios. Specifically, the

inventors have created an harmonic bell in which at least the first three modal frequencies are in the ratios 1, 2, 3. This has hitherto not been considered possible, and indeed, researchers in this area have not pursued such a bell because such characteristics are so far removed from conventional thinking. The inventors of the present invention have completely departed from such conventional thinking. As the Lehr paper (included in the IDS, "Designing Chimes and Carillons in History"), makes clear in Section 3.2, page 20, conventional thinking has led to the common understanding that an harmonic bell is an impossibility, and that this is "a musically disturbing fact." Remarkably, the inventors have succeeded in creating what has hitherto been deemed impossible. It is respectfully submitted that, in view of this creation, the novelty cannot be questioned.

Fountain describes a numerical shape optimisation aiming for a 'clarinet timbre,' with frequencies of 1, 3, 5 and 7, being the 'odd harmonics.' This objective was not in fact achieved (see Page 5, lines 12-20 of the present specification) due to the very large errors. From the Table 2 results, it is clear that when the errors are calculated in the normal way, with respect to the fundamental frequency (Mode 1), then the first harmonic has an error of 9.3%. This is greater than a semitone, and errors of this magnitude make the result musically unacceptable.

Notwithstanding this fact, Fountain does not describe 'a harmonic sequence,' and does not set out to produce one. In an harmonic sequence, the frequency modes have the exclusive ratio set 1, 2, 3, etc. For the Examiner's convenience, we enclose an extract from the Collins Encyclopedia of Music, pages 20-21, published in 1985 by Chancellor Press (see **Appendix A** attached). This makes very clear that an harmonic sequence must be complete (i.e. must not skip a mode, and must not include non-harmonic modes). The extract also evidences the conventional mindset prior to the present invention, namely that a bell could not produce modes falling into an harmonic sequence.

The production of an harmonic modal sequence is very different from the teaching of Fountain. The Examiner makes reference to Table 1 of Fountain, wherein it is noted that the conventional minor third tuning of a classical bell is shown, **not** an harmonic modal tuning. Moreover, Fountain teaches nothing that would lead one skilled in the art to achieve the subject matter of the present invention.

Turning to Schoofs, this document teaches the systematic optimisation to a major third tuning of a bell (1, 2, 2.5, 3, 4), involving the adaptation of the minor third bell shape. Whilst a very illuminating article, this publication is in no way relevant to the subject matter in question, and does not even discuss the idea of an harmonic sequence.

In summary, the prior art relied on by the Examiner has not even suggested one might attempt to create an harmonic bell, let alone how this might be accomplished. The invention as defined by the claims is therefore neither anticipated nor obvious thereover.

The above amendments address the Examiner's rejections and render any other rejection found in the Office Action moot because the claims have been otherwise distinguished from the prior art reference. In view of the amendments to the claims and the foregoing remarks, it is believed that the present application is in condition for final allowance and notice to such effect is respectfully requested.

If the Examiner believes that additional issues need to be resolved before this application can be passed to issue, the undersigned invites the Examiner to contact him at the telephone number provided below.

Respectfully submitted,

Dated: May 14, 2002

By _____
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VERSIONS WITH MARKINGS TO SHOW CHANGES MADE

1. (Amended) A bell having [the] a plurality of modal frequencies, a first at least three frequencies being substantially in an harmonic sequence.

2. (Amended) A bell [having the] as claimed in claim 1, wherein said first at least three frequencies, [substantially in an harmonic sequence wherein all the tuned frequencies] are due to modes with no ring nodes.

3. (Amended) A bell as claimed in claim 1, wherein, of the modal [having the first at least three frequencies substantially in an harmonic sequence wherein, of the tuned] frequencies, the frequencies due to modes with no ring nodes are all below any frequencies due to modes with ring nodes.

13. (Amended) A bell having [the] a plurality of modal frequencies, a first at least four frequencies being substantially in a harmonic sequence.

15. (Amended) A method for designing a bell shape for a bell having [the] a plurality of model frequencies, a first at least three frequencies substantially in an harmonic sequence, the method comprising the steps of selecting an initial bell shape and using the initial bell shape in an optimisation procedure for modifying the bell shape such that [the] said first at least three frequencies are substantially in an harmonic sequence.

16. (Amended) A method according to claim 15 wherein the initial bell shape is such that, of [the] said modal frequencies [to be tuned], all the frequencies due to modes without ring nodes are below any frequencies due to modes with ring nodes.

22. (Amended) An axisymmetric bell having a top portion, a side portion and a mouth, the side portion extending from the top portion to the mouth, a meridonal cross-section of the side portion being substantially geometrically similar to a cross-section having:

(a) an outer line formed by fitting an arc of a circle to [the] three points [the] having rectangular coordinates [of which are] x, y of the nodes as set out in table 3; and

(b) an inner line formed by fitting a line to [the] points [the] having rectangular coordinates [of which are] x, y of the nodes as set out in table 2.

23. An axisymmetric bell having a top portion, a side portion and a mouth, the side portion extending from the top portion to the mouth, a meridonal cross-section of the side portion being substantially geometrically similar to a cross-section having:

(a) an outer line formed by joining a straight line to [the] two points [the] having rectangular coordinates [of which are] x, y of the nodes as set out in table 6; and

(b) an inner line formed by fitting a line to [the] points [the] having rectangular coordinates [of which are] x, y of the nodes as set out in table 5.